



Oregon

Theodore Kulongoski, Governor

Department of Environmental Quality

Northwest Region Portland Office

2020 SW 4th Avenue, Suite 400

Portland, OR 97201-4987

(503) 229-5263

FAX (503) 229-6945

TTY (503) 229-5471

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Also Sent Via E-mail

Mr. Robert J. Wyatt
Northwest Natural Gas Company
220 N.W. Second Avenue
Portland, OR 97209

**Subject: Proposed Groundwater/NAPL Pilot Program
Northwest Natural Gas Company Site
Portland, Oregon
ECSI No. 84**

Dear Mr. Wyatt:

The Department of Environmental Quality (DEQ) has reviewed the "Groundwater/NAPL Pilot Program, Extraction Well and Performance Evaluation Design Report" dated May 2007 (Pilot Program). Anchor Environmental, LLC (Anchor) prepared the Pilot Program on behalf of the Northwest Natural Gas Company (NWNG). The Pilot Program provides an updated approach for assessing groundwater extraction wells as a source control technology in the southeast corner of property owned by NWNG (NWNG Property).

DEQ has determined that source control is required along entire shoreline of the NWNG Property and the northern portion of the property owned by the Siltronic Corporation (Siltronic Property). The portion of the shoreline identified as the highest priority for source control (Segment 1) extends from downstream of the "Tar Body Removal Area" (TBRA) on the NWNG Property, to upstream of the "lowland effluent overflow pond area" (EPOA) on the Siltronic Property. Segment 1 coincides with the:

- Heaviest impacts associated with NWNG's former manufactured gas plant (MGP) operations, including dense non-aqueous phase liquid (DNAPL) and contaminated groundwater, identified near the river; and
- The portion of the Siltronic Property where groundwater contamination caused by Siltronic has commingled with MGP-related groundwater contamination and DNAPL.

The segment of NWNG's shoreline between the TBRA and NWNG's downstream property line with US Moorings (Segment 2) is considered a high priority for source control due to the presence and concentrations of cyanide in soil and groundwater.

DEQ is requiring that source control measures be implemented along segments 1 and 2 to prevent migration of DNAPL, contaminated groundwater, and erodible soils to the Willamette River. A third shoreline segment (Segment 3) extends from upstream of the EPOA to the upstream Siltronic Property line. A source control evaluation of this segment is ongoing.

NWNG is currently investigating segments 1 and 2 to develop the data necessary for evaluating source control measures for the groundwater/DNAPL focused feasibility study (FFS). NWNG and DEQ have discussed source control measures technologies and agree that:

- Extraction wells and vertical barriers are a proven containment technologies;
- Implementation of these technologies on the NWNG and Siltronic properties is feasible; and

- Extraction wells and vertical barriers are technologies that will be carried forward into the FFS.

The Pilot Program focuses on further evaluating the influence of pumping extraction wells on DNAPL and contaminated groundwater in the fill and alluvial water-bearing zones (WBZs) of Segment 1 in the southeastern corner of the NWNG Property.

DEQ's comments are provided below and document discussions and agreements reached regarding the scope of work, and clarify our expectations regarding source control data needs and/or the objectives of the Pilot Program.

GENERAL COMMENTS

Scope of Work

The Pilot Program provides an updated approach for assessing groundwater extraction wells as a source control technology in the southeast corner of the NWNG Property. The scope of work for the Pilot Program does not: 1) consider the location (relative to the extraction wells and river), depth, and/or alignment of a vertical barrier, and 2) does not propose a sampling scheme to support a preliminary evaluation of the treatability of extracted groundwater. DEQ considers this information essential for preparing the FFS.

During a telephone discussion on May 18th, DEQ informed Anchor that: 1) due to the risk of having to decommission and replace the extraction wells during construction of a vertical barrier, and 2) lacking a proposal for a preliminary treatability evaluation, the scope of work for the Pilot Program should be substantially modified as described below.

- Previously NWNG constructed and tested an extraction well (PW-01-80) that provided data regarding the hydraulic properties and groundwater chemistry of the upper 80 feet of the alluvial WBZ¹. Based on selected data from existing and new monitoring wells (monitoring well clusters MW-18, MW-19, and MW-20), and near shore borings located along segments 1 and 2, an apparent concentration break occurs at a depth of approximately 125 feet below ground surface (bgs). Accordingly, the Pilot Program proposed installing five extraction wells screened between 75 feet and 118 feet bgs.

Based on recent discussions with Anchor, the Pilot Program will now include the drilling, installation, and testing of only the PW-04 extraction well pair. The PW-04 pair was selected because they are located at or near the concentration break interpreted by NWNG and within a highly contaminated portion of the alluvial WBZ. In addition, DNAPL was observed during drilling of the MW-20 boring in close proximity to, and within the screened interval of PW-04-85.

The data collection objectives for testing PW-04 will include, but are not necessarily limited to the following:

- Evaluating the performance of the paired well design;
- Providing estimates of the hydraulic properties of the alluvial WBZ influenced by pumping PW-04, to a depth of approximately 120 feet bgs near the middle of Segment 1;
- Evaluating the horizontal and vertical capture zone of PW-04;

¹ Hahn and Associates, Inc., 2005, "Aquifer Test Evaluation Report, NW Natural – Gasco Facility, 7900 NW St. Helens Road, Portland, Oregon," October 14, a report prepared on behalf of the Northwest Natural Gas Company.

- Assessing DNAPL and contaminated groundwater capture in an area of known groundwater contamination where DNAPL has been observed; and
- Collecting information on contaminant levels in the extracted water.

This information will supplement previous work completed in Segment 1 (e.g., PW-01-80 aquifer test, near shore borings, geologic interpretations, and grain-size analyses), and provide information regarding deeper portions of the alluvial WBZ (e.g., 75 feet to 118 feet bgs). Additionally, DEQ understands from NWNG that the Pilot Program as modified above will provide information that can be applied to Segment 2.

DEQ further understands that the modified Pilot Plan will support the modeling work described in Section 5.0, including evaluating the locations, numbers, and depths of extraction wells and the adequacy of the existing monitoring well network. Ultimately work completed in segments 1 and 2 must provide sufficient information to fully support the numerical simulations of hydraulic containment using various extraction well/vertical barrier combinations that will be performed during the FFS.

Segment 2

To date, site characterization work and source control work has focused on Segment 1. As discussed above, DEQ is also requiring source control to be conducted in Segment 2. The scope of work does not recommend any work to evaluate the hydraulic properties or groundwater treatability for Segment 2. The Pilot Plan is deficient in this respect.

DEQ concludes that because of the unusual inorganic chemistry of groundwater, additional work will be needed within Segment 2 to support the FFS. The general groundwater chemistry in Segment 2 (e.g., levels of dissolved iron and manganese) could prove to be a significant factor in the long term operation and maintenance of extraction wells (e.g., encrustation, fouling, localized reduction in formation transmissivity, increased maintenance time) and treatment system components (e.g., encrustation, fouling, clogging, increased maintenance time).

DEQ is reviewing NWNG's proposal to drill and install monitoring wells along Segment 2. Subsequent to receiving the results from the initial groundwater monitoring event at these wells, DEQ expects NWNG to present an approach for assessing the hydraulic properties and treatability for Segment 2 that will fully support groundwater modeling and the FFS. Postponing the FFS, or submitting an incomplete FFS due to lack of representative information for Segment 2 will not be acceptable.

Depth of Extraction Wells

NWNG has identified benzene, naphthalene, and cyanide (i.e., total, amenable, and free forms) as "key constituents" to use in assessing groundwater contamination associated with MGP waste. Based on the vertical distribution of benzene and naphthalene, NWNG has interpreted a break in contaminant concentrations at a depth of about 125 feet bgs (approximately -100 feet mean sea level). The depths of the extraction wells proposed in the Pilot Program are based on this interpretation.

NWNG should be advised that DEQ does not consider the three chemicals referenced above to be adequate for delineating the nature and extent of contamination. For example, relevant ecological criteria for toluene, ethylbenzene, and xylenes are lower than benzene. DEQ expects NWNG to fully evaluate the nature and extent all MGP waste chemicals of interest (COI) in the FFS. As such, it is premature for

NWNG to place vertical limits on hydraulic containment within the alluvial WBZ.

SPECIFIC COMMENTS

Introduction. The second paragraph implies that NWNG considers hydraulic containment using extraction wells to be a viable stand-alone source control measure alternative. As DEQ has indicated previously, extraction wells alone are unlikely to meet the source control objectives (i.e., prevent DNAPL migration to the river; prevent recontamination of the river). In addition, NWNG should be advised that the U.S. Environmental Protection Agency has indicated to DEQ that extraction wells alone will probably not be compatible with the removal-based Early Action being contemplated off-shore of the NWNG and Siltronic properties.

Section 2.3. DEQ concurs with NWNG that based on grain-size analyses, the grain-size of the alluvial unit increases with depth. DEQ's review suggests that the alluvial unit can be organized into three "zones" based on grain-size. The third zone consists of mixtures of medium and coarse sand, and gravel at depth.

As shown in Figure 3, the stratigraphy of the alluvial unit may be difficult to correlate based on visual observations made during drilling. The three "zones" preliminarily identified by NWNG and DEQ provide an alternative method for interpreting and depicting the subsurface geology across segments 1, 2, and 3.

Section 3.2. Subsequent to submittal of the Pilot Program and upon further consideration of the inorganic groundwater chemistry, NWNG proposed modifying the extraction well screen and filter pack specifications in an e-mail sent May 18th (i.e., all wells to have screens with 0.035-inch slots and filter packs consisting of 10/20 sand). This letter provides DEQ's approval of the material specifications change.

Section 4.1. The aquifer test plan is presented in this section of the Pilot Program. DEQ's comments are provided below numbered consistent with the Pilot Program.

1. The totalizing flow meter should also provide measurements of instantaneous discharge, and should be checked and calibrated prior to initiating performance testing.
2. NWNG revised Table 5 after the May 18th telephone discussion regarding the change in the Pilot Program scope of work. The revised version of the table was sent via e-mail on May 25th and provides NWNG's recommended network of installations to monitor the PW-04 performance tests. Ten monitoring wells are included in the network ranging in depth from 32 feet to 180 feet bgs. This letter provides DEQ's approval of the revised table.
4. Additional information is needed regarding the strategy NWNG will use to evaluate and account for tidal fluctuations in observation and extraction wells during performance testing.
5. As discussed under General Comments, an objective of the testing plan is two evaluate the performance of the dual extraction well design. As such, DEQ expects that PW-04-85 and PW-04-118 will be performance tested individually and jointly.

6. The proposed approach for collecting samples during extraction well performance testing is inadequate. DEQ expects groundwater samples to be collected at the extraction well being tested at 10 minutes, 100 minutes, 1,000 minutes, and at the end of the pumping period. Groundwater samples should be analyzed for the principal site COI, including total/amenable/free cyanide and selected treatability parameters (e.g., iron and manganese). The results of the June 2007 groundwater event scheduled for later this month can be utilized for pre-test groundwater chemistry. In addition, DEQ understands that per agreements made with Siltronic, NWNG is going to collect groundwater samples from monitoring wells in the WS-14 cluster for analysis of volatile organic compounds.

Section 4.2. In addition to the interference factors listed in this section, the change from a storativity to specific yield as groundwater levels are drawn down below the silt unit could influence the data collected during performance tests.

Section 5.1. The second paragraph indicates the model domain extends to the east side of the Willamette River. DEQ assumes the NWNG meant the west bank of the river.

The third paragraph describes the model grid. Hydraulic property assignments are not provided. Without this information DEQ cannot complete our review of this section or figures 11, 12a, and 12b. DEQ expects this information to be fully documented in a future submittal.

Section 5.3. As indicated in our comment to Section 5.1, lacking information about the hydraulic properties used in the model, DEQ cannot comment on the representativeness of the figures referenced in this section.

Section 5.4. In addition to DNAPL migration to the river, DNAPL movement into deeper intervals of the alluvial WBZ is also of concern to DEQ. Migration into deeper intervals could result in the relocation of sources of dissolved-phase contamination into depth intervals not considered during source control measures planning. DEQ expects this scenario to be further evaluated in the FFS.

NWNG notes that studies at other sites have determined that, "...hydraulic gradients of at least 1 are required to mobilize *residual NAPL* (italics added for emphasis) in alluvial sands similar to those present in the alluvium..." There is ample evidence based on sample testing (measured DNAPL saturation of approximately 50%), observations made in the field during drilling, accumulation of DNAPL in monitoring wells, and the appearance of DNAPL in areas where it was not previously observed, to conclude that mobile DNAPL occurs on the NWNG and Siltronic properties. Where saturation levels are greater than residual and/or DNAPL is mobile, hydraulic gradients of less than 1 can cause DNAPL movement.

DEQ will expect NWNG to assess potential DNAPL mobility under reasonable site-specific conditions. NWNG's assessment should emphasize the potential for DNAPL to migrate vertically. Information available from other sites can assist with this work, especially if the physical and chemical properties of the DNAPL and material properties of the subsurface are similar to those observed at segments 1 and 2.

An important objective of the performance test and subsequent groundwater modeling will be to determine the adequacy of the existing monitoring well network with respect to demonstrating horizontal and vertical containment. DEQ anticipates that recommendations for additional monitoring wells, if needed, will be made based on the limits and locations of capture zones and stagnation points predicted from groundwater modeling.

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NEXT STEPS

DEQ is not requesting NWNG to revise and resubmit the Pilot Program. This letter serves to document the scope of work and DEQ expectations under the condition that: 1) our comments to Section 4 are responded to, or incorporated into the PW-04 performance testing plan, as appropriate; and 2) our remaining comments are addressed in future deliverables, notably the FFS.

DEQ appreciates NWNG's work to evaluate and address MGP waste and associated contamination on the NWNG and Siltronic properties. Please don't hesitate to contact me if you have questions regarding this letter.

Sincerely,

Dana Bayuk
Project Manager
Portland Harbor Section

Cc: Sandy Hart, NWNG
Patty Dost, Schwabe Williamson & Wyatt
Rob Ede, Hahn & Associates
John Edwards, Anchor Environmental
Carl Stivers, Anchor Environmental
Tom McCue, Siltronic
Alan Gladstone, Davis Rothwell Earle & Xochihua
James Peale, Maul Foster & Alongi, Inc.
Eric Blischke, EPA
Chip Humphries, EPA
Kristine Koch, EPA
Sean Sheldrake, EPA
Henning Larsen, DEQ/SRS
Jim Anderson, DEQ/PHS
Matt McClincy, DEQ/PHS
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